

## LETTERS TO THE EDITOR.

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## The Origin of Radium.

In a previous letter to NATURE (January 17) I gave an account of some experiments which I had made upon the growth of radium in preparations of actinium. The results obtained were in substantial agreement with the earlier observations of Boltwood in this Journal (November 15, 1906), but it was pointed out that there was no definite evidence that actinium itself was the true parent of radium. The experimental results could be equally well explained by supposing that the parent substance of radium was ordinarily separated from radio-active ores with the actinium, but had no direct radio-active connection with the latter.

Observations have been continued upon the growth of radium in the actinium solution prepared in the manner indicated in my first letter. The rate of growth was found to be uniform over a period of 120 days, and to agree closely with the rate of growth observed in the solid preparation of actinium which had been set aside for a period of two and a half years. Another sample of actinium was then taken and successively precipitated with ammonium sulphide in order to remove the radium from the solution. In this way a solution of actinium was obtained initially almost entirely free from radium. By examination of the  $\alpha$ -ray activity, it was found that the actinium after this chemical treatment contained an excess of radio-actinium. This was shown by the rise of the activity to twice its initial value in about twenty days, and then a gradual decay to a steady value. Special care was taken to measure accurately the rate of growth of radium in the solution at short intervals in order to see whether it depended in any way upon the variation of the activity. No such connection was observed, for the radium was produced at a constant rate over the whole period of examination, viz. 111 days.

For equal quantities of actinium, the rate of growth of radium observed in this solution was 1.5 times greater than the normal. This indicated that only a portion of the actinium had been precipitated, while the radium-producing substance had been precipitated with the actinium in excess of the normal amount. This conclusion was confirmed by an examination of the filtrates, which were found to contain more than half the actinium. After suitable chemical treatment, a small precipitate of actinium was again obtained which was about one hundred times as active, weight for weight, as the original preparation. This actinium precipitate was dissolved in hydrochloric acid, and observations of the amount of radium in it were made at regular intervals. *No appreciable growth of radium was observed over a period of eighty days.* If there were any growth at all, it was certainly less than one two-hundredth part of that normally to be expected. In order to make certain that the absence of apparent growth of radium in this solution could not be ascribed to the precipitation of the radium in some non-emitting form, the solution was again chemically treated. The actinium was precipitated with ammonia and re-dissolved in hydrochloric acid. Again no growth was observed over the period of examination, viz. twenty days. The solution in its present state contains a just measurable quantity of radium, viz. about  $2 \times 10^{-12}$  gram.

From these observations I think we may safely conclude that, in the ordinary commercial preparations of actinium, there exists a new substance which is slowly transformed into radium. This immediate parent of radium is chemically quite distinct from actinium and radium and their known products, and is capable of complete separation from them.

It is not possible at present to decide definitely whether this parent substance is a final product of the transformation of actinium or not. It is not improbable that it may prove to be the long-looked-for intermediate product of slow transformation between uranium X and radium, but with

no direct radio-active connection with actinium. If this be the case, the position of actinium in the radio-active series still remains unsettled.

It is intended to continue observations on the growth of radium in the solutions described above. Experiments are also in progress to isolate this new substance in order to examine its chemical and radio-active properties.

Manchester, May 30.

E. RUTHERFORD.

## The Structure of the Ether.

I WELCOME the interesting and helpful letter from Dr. O. W. Richardson, of Princeton, in NATURE of May 23, in which he adduces arguments against an ether flow along magnetic lines of force, and in favour of a flow in the direction of the Poynting vector EH. The result comes out much the same, but it is probably a better way of regarding the matter. Prof. Hicks also has given a simple geometrical proof that a magnetic field cannot consist solely of ether flow; and I am referring to this in a note, already printed, in the Phil. Mag. for June.

We shall doubtless hear in due course from the mathematical physicists to whom the first idea of a magnetic ether flow is due, whether they are satisfied with the modification of their original conception now introduced. Meanwhile, I doubt if integration of momentum, without regard to direction, can be sound.

OLIVER LODGE.

Birmingham, May 28.

## Root Action and Bacteria.

THE remarkable and all but fatal effect of growing grass over the roots of freshly planted apple trees has been studied at the Woburn Experimental Fruit Farm since 1894, and formed the subject-matter of the third report of that station (1903). No satisfactory explanation of the action was obtained. Experiment showed that it could not be attributed to the abstraction of food or moisture from the soil by the grass, nor to the influence of the grass on the soil temperature or on the gaseous contents of the soil, and subsequent experiments have excluded the formation of acid or alkali from the possible causes. The conclusion drawn was that the action was probably that of a poison produced either directly by the grass or indirectly through the agency of bacteria. Since the publication of this report, further work has been done on the subject, and the view that bacterial agency is concerned has become much strengthened. The action is not confined to any particular grasses, nor to apple trees, but different grasses and different kinds of trees act and suffer, respectively, to different extents. The difference in the results, however, produced by different soils are much more conspicuous, especially in cases where trees are not grassed over until a few years after they have been planted. Though the deleterious action of grass may generally be noticed throughout the country, many notable exceptions have been met with, and these cannot be explained by any of the patent characteristics of the soils in question. Various pot experiments have been made which emphasise these observations. Trees grown in earth in pots are affected by grass in just the same way as they generally are in the field, the grass reducing the growth and vigour of the tree by at least 50 per cent.; but if the trees are grown in sand instead of earth (suitable nourishment being supplied), the grass has very little effect on them, reducing their vigour by about 5 per cent. to 10 per cent. only.

Following up this and other observations, twenty-six similar trees were planted in pots last February under various conditions; seventeen of them were in soil or sand which had not been heated, and nine of them in soil which had been sterilised, or partially sterilised, by heating to about  $200^{\circ}$  C. and to  $82^{\circ}$  C. respectively, the water lost in the process being made good. Of the seventeen in unsterilised material, all started into growth uniformly at the same time, whereas of the nine in sterilised soil two started about two days later, six did not start until at least fourteen days later, and one has not started yet.

The heating of the earth, especially to the low temperature of  $82^{\circ}$ , cannot have appreciably affected its chemical composition, and, indeed, the starting of a tree into growth is independent of nourishment supplied to it, as is shown

by the behaviour of trees in sand; the only alteration produced in the soil by the heating must have been an alteration in the living organisms present in it. That bacteria are connected with root action has, of course, been established in certain special cases, but in these the connection consists of the bacteria being the means of augmenting the food supply of the plant; the present case is altogether different, for it appears as if the mere functioning of the roots was dependent on bacterial action. Such a conclusion would be one of far-reaching significance. Of course, the facts require much more examination and confirmation, but, even in their present state, they are sufficiently evident to warrant notification.

That two out of the nine trees in sterilised soil showed very little retardation in activity is not surprising, as there were many opportunities for the re-inoculation of the soil, the pots containing the trees having been exposed in the open since February 4, and no attempt having been made to sterilise the trees themselves before planting, though the roots were washed free from soil. The two exceptional trees were in earth which had been heated to the higher temperature; they were two out of six planted under these conditions. It may also be mentioned that heating to the lower temperature does not destroy all soil bacteria, indeed, it may increase the total bacterial contents; it is probably, therefore, a question of killing some particular bacteria which are connected with root activity.

SPENCER PICKERING.

#### The Astronomical and Archaeological Value of the Welsh Gorsedd.

FROM the very interesting communication of the Rev. John Griffith (May 2, p. 9) it would at first sight appear that the modern "Druids" had indeed preserved a tradition of the May year as well as of the solstitial year in connection with the circles set up by them for the performance of their ceremonies. I should be glad to think that this was the case, but I find considerable difficulty in connecting the modern circles with the ancient ones; there is no ancient circle which shows any sign of ever having possessed such an array of outlying stones as appears in the plan given by Mr. Griffith, and the outlying stones that remain do not always conform to it either; nor is there any ancient circle, except those in which a sepulchral cist forms the central point, and Stonehenge, which has a flat stone in the centre. The late "Myfyr Morganwg, Archdruid of Wales," set up a circle round the rocking stone at Pontypridd in the middle of the last century, but in place of the eight outlying stones figured by Mr. Griffith it has curved avenues forming the head and tail ends of a serpent, so it does not appear that modern "Druidic" authorities are agreed upon this important subject. "Myfyr Morganwg" also published a book in Welsh, the principal illustration to which represents a Druid standing on a flat stone (sometimes it is a three-legged dolmen), surrounded by a circle of twelve others, on which converge three rays of light coming from the north-east, east, and south-east, and forming, no doubt, the original model of the "broad arrow" and of the "Y cross," but without any outlying stones, though three smaller stones are represented in those lines inside the circle; three stones which may represent these, or may, with others there, be intended for an inner circle, also exist in his Pontypridd circle. The central stone for sitting or standing on seems to be a *sine qua non* with the modern "Druids," but it is not found in ancient circles. There are upright stones in the middle of the circles at Callernish, Boscaen-un, the Stripple Stones, and the Marshpool or Hoar-stone circle (Shropshire), and there was one in the middle of the southern inner circles at Avebury, where also the middle of the northern inner circles was occupied by a "cove," or open shrine of three stones, as again was the case at Arborlow, but at none of these places, except perhaps in the Shropshire circle, could any man stand or sit on these stones, though he might stand in front of them. In the other great British circles (Stonehenge, which occupies a place by itself amongst them, excepted) there is nothing in the centre nor any appearance of there ever having been

anything, although there is reason to believe that whatever was done in them was done at or about the centre.

I am therefore inclined to think that the type of circle represented by Mr. Griffith, and probably much of the ritual connected with it, were evolved during the process of "re-codifying or otherwise dealing with the bardic traditions," which, as he says, took place between the twelfth and nineteenth centuries, when, as he also says, a "voluminous body of traditions grew up," and that whatever old ideas may be preserved amongst those traditions have got there rather in an accidental sort of way than by continuous use or direct descent. The traditions, however, though of no real authority in matters of detail, are not without value as indications of an opinion of very great antiquity as to the use of the ancient circles.

The number nineteen occurs at Stonehenge, Dawns Maen, Boscaen-un, the Cosdon circle (Dartmoor), and in the proportionate measurements of Stanton Drew. It probably refers to the cycle of nineteen years in which the sun and moon were thought to return to the same relative place in the heavens, and which was known in the fourth century B.C., if not, indeed, much earlier, in the island described by Hecataeus, usually identified with Great Britain.

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I AM glad that a brief summary of the evidence for the antiquity of the Welsh Gorsedd has interested Mr. A. L. Lewis.

(1) The name "Druids" for the Welsh bards should be dropped. It is retained at the Gorsedd as the name of one of the three classes of members. There is very little authority for calling the presiding bard archdruid. The proper name is Priv-vardd, Chief Bard. Let "Druids" and "Druidism" remain as general terms for the use of the "pre-historian." The Welsh bards insist on a grander name, *Gorsedd Beirdd Ynys Prydain*, the high court of the bards of the Isle of Britain.

(2) As to the May year, it has not become obsolete in Wales. There is practically no other in our ancient literature. Its omission from the conventional Gorsedd instructions, while it is everywhere present in the bardic traditions with that exception, is, I think, due to monastic influence. The Church year became solstitial. The bards fraternised with the monks, and Gorsedsds were held in chapter-houses and churches. One result was that the bards adopted the festival year as fixed by the Church, so that the favourite time for a Gorsedd was neither solstitial nor agricultural, but such a time as Whitsuntide. This, the only serious meddling with the traditions that I can find, was done, say, about the twelfth century, when the Cistercian monks of Margam, Glam., where the Gorsedd traditions were chiefly preserved, found a new use for the Gorsedd, as a model for the round or polygonal chapter-house.

(3) It is not likely that a stone circle can be found exactly like a Welsh Gorsedd. In the earliest traditions, like those of the oldest Mabinogion, we seem to find the temple observatory in actual use, say, by the Druids; but, speaking generally, in the Gorsedd traditions themselves it is only a matter of minor importance, preserved as well as such a comparatively useless thing could be for the sake of some sacred associations. Modern bards do not understand the plans they have preserved. When a new Gorsedd is set up, no account is taken of the height of the horizon in the direction of the sunrise stones, a matter of much importance to the builders of the megalithic monuments. The bards have religiously preserved the general plan. At some point of time, when it was deemed necessary to preserve such a thing after it had ceased to be of practical use, the bards did better than copying any individual monument, which, as a rule, gives only one decisive sight-line to sunrise or sunset. They set up a complete almanac in stone. The perfect plan I have directed attention to (NATURE, May 2) presents sight-lines to the quarter days of both the solstitial and May years. As the individual monument is usually oriented to some one festival day, uniformity in detail is not to be looked for. The Gorsedd presents in one plan the combined sunrise sight-lines of all the circles in fair preservation that have been astronomically surveyed.